UNIVERSITY OF MANITOBA

October 14, 2010
(7:00 PM – 9:00 PM)

MID-TERM TEST
Formula Sheet

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DEPARTMENT & COURSE NO.: PHYS 1050

TIME: 2 hours

EXAMINATION: Physics 1: Mechanics

EXAMINERS: C.-M. Hu, F. Lin, G. Williams

Mathematics

Quadratic equation:

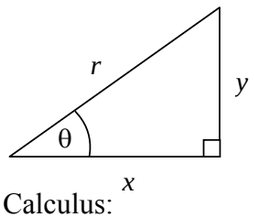
$$ax^2 + bx + c = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Trigonometry:

$x^2 + y^2 = r^2$

$\sin\theta = y/r$
$\cos\theta = x/r$
$\tan\theta = y/x$



$$\tan\theta = \frac{\sin\theta}{\cos\theta}$$

Calculus:

$$\frac{d}{dt}(a \cdot t^n) = a \cdot n t^{n-1}$$

$$\int x^n dx = \frac{x^{n+1}}{n+1}$$

Constants and Units

$k = 10^3$, $\mu = 10^{-6}$, $n = 10^{-9}$

$c = 3.0 \times 10^8$ m/s
$g = 9.80$ m/s^2

Translational Kinematics

Three dimensions:

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\vec{v}_{av} = \frac{\Delta\vec{r}}{\Delta t} = \frac{\vec{r}_2 - \vec{r}_1}{t_2 - t_1} \qquad \vec{v} = \lim_{\Delta t \to 0} \frac{\Delta\vec{r}}{\Delta t} = \frac{d\vec{r}}{dt}$$

$$\vec{a}_{av} = \frac{\Delta\vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{t_2 - t_1} \qquad \vec{a} = \lim_{\Delta t \to 0} \frac{\Delta\vec{v}}{\Delta t} = \frac{d\vec{v}}{dt}$$

One dimension:

$$v_{x,av} = \frac{\Delta x}{\Delta t} \qquad v_x = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t} = \frac{dx}{dt}$$

$$a_{x,av} = \frac{\Delta v_x}{\Delta t} \qquad a_x = \lim_{\Delta t \to 0} \frac{\Delta v_x}{\Delta t} = \frac{dv_x}{dt}$$

Constant acceleration in one dimension:

$$x = x_0 + v_{0x} t + \frac{1}{2} a_x t^2$$

$$v_x = v_{0x} + a_x t$$

$$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$$

Uniform circular motion:

$$a = \frac{v^2}{r}$$

Particle Dynamics

$$\Sigma \vec{F} = m\vec{a} \qquad f_s \le \mu_s N$$

$$W = mg \qquad f_k = \mu_k N$$

N = normal force

Relative Motion

$$\vec{v}_{PA} = \vec{v}_{PB} + \vec{v}_{BA}$$

(PA means velocity of P relative to A, etc.)

Work, Kinetic Energy, Potential Energy

$$W = \vec{F} \cdot \vec{s} \qquad W = \int_A^B \vec{F} \cdot d\vec{s}$$

$$\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}| \cos\theta \qquad K = \frac{1}{2} m v^2$$

$$W = \Delta K = K_f - K_i \qquad E = K + U$$

$$U_s = \frac{1}{2} k x^2 \quad \text{(spring)}$$

$$U_g = mgz \quad \text{(gravity)}$$

$$\text{Power} = \frac{dW}{dt} = \vec{F} \cdot \vec{v}$$